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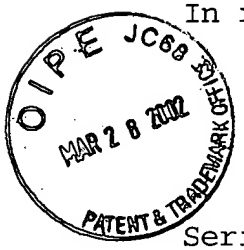

49 Appeal Brief Entered 4-5-02

In re application of:

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ALAN G. WOOD
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Art Unit: 2858

Serial No.: 08/838,452

Filing Date: April 7, 1997

Examiner: Karlsen, E.

Title: TEST APPARATUS FOR TESTING SEMICONDUCTOR DICE INCLUDING SUBSTRATE WITH PENETRATION LIMITING CONTACTS FOR MAKING ELECTRICAL CONNECTIONS (AS AMENDED)

Attorney Docket No.: 91-62.17

APPELLANT'S BRIEF (37 CFR 1.192)
March 28, 2002

Honorable Commissioner of Patents
Washington, DC 20231

ATTENTION: Board of Patent Appeals and Interferences

This Brief is submitted in triplicate in response to an appeal to the Board of Patent Appeals and Interferences dated February 5, 2002, from the final rejections of the Examiner contained in the final Office Action dated October 5, 2001.

This Brief is accompanied by the requisite fee under a separate transmittal and is filed within two months of February 5, 2002, the date of the Notice of Appeal. The claims under appeal are included as an Appendix.

1. REAL PARTY IN INTEREST (37 CFR 1.192 (c) (1))

The real party in interest in the appeal is Micron Technology, Inc., the assignee of record of the patent application.

2. RELATED APPEALS AND INTERFERENCES (37 CFR 1.192 (c) (2))

There are no other appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in this appeal.

3. STATUS OF CLAIMS (37 CFR 1.192 (c) (3))

Claims 78-83 and 87-98 are pending in the application.

Claims 83, 89, 94 and 95 have been withdrawn from consideration.

Claims 78-82, 87, 88, 90-93 and 96-98 have been rejected under 35 USC 103(a) as being unpatentable over Malhi et al. (US Patent No. 5,088,190) or Elder et al. (US Patent No. 5,123,850) in a first set, in view of Nakano (JP Hei 3-69131) in a second set, and Blonder et al. (US Patent No. 4,937,653) or Bindra et al. (US Patent No. 5,137,461) in a third set.

Claims 78-82, 87, 88, 90-93 and 96-98 have been rejected under 35 USC 103(a) as being unpatentable over Nakano (JP Hei 3-69131) in a first set, in view of Blonder et al. (US Patent No. 4,937,653) or Bindra et al. (US Patent No. 5,137,461) in a second set.

The final rejection of claims 78-82, 87, 88, 90-93 and 96-98 is being appealed.

4. STATUS OF AMENDMENTS (37 CFR 1.192 (c) (4))

No amendments have been filed subsequent to the final rejections contained in the final Office Action dated October 5, 2001.

5. SUMMARY OF INVENTION (37 CFR 1.192 (c) (5))

The rejected claims are directed to an "apparatus for testing semiconductor dice having a plurality of pads". The apparatus (fixture 11-Figure 8) includes a plate for retaining the die (die cavity plate 13-Figure 8), and a clamping mechanism (clamp 89-Figure 8). The testing apparatus also includes a substrate (41-Figure 6) configured to make temporary electrical connections with the die (21-

Figure 6) held in the testing apparatus (fixture 11-Figure 8). The substrate (41-Figure 6) includes contacts (61-Figure 8) with raised portions (73-Figure 6) for penetrating pads (27-Figure 6) on the die (21-Figure 6) to a self limiting penetration depth.

The contacts (61-Figure 8) are constructed such that a biasing force with which the clamping mechanism (clamp 89-Figure 8) presses the die (21-Figure 6) and the substrate (41-Figure 6) together is sufficient to cause the raised portions (73-Figure 6) on the contacts (61-Figure 8) to penetrate the pads (27-Figure 6) on the die (21-Figure 6). This is the lower limit of the biasing force. At the same time, the biasing force is selected to be less than a force required for the remaining portions of the contacts (61-Figure 8) to penetrate the pads (27-Figure 6) on the die (21-Figure 6). This is the upper limit of the biasing force. On page 18, lines 9-15 of the specification, the upper limit is stated to be from two to ten times the lower limit.

A reading of independent claims 78, 87, 92 and 97 on the specification and drawings is as follows.

78. An apparatus **(fixture 11-Figures 1 & 2)** for testing a semiconductor die **(21-Figure 2)** having a plurality of pads **(27-Figures 1-3)** comprising:

a plate **(13-Figures 1 & 2)**;

a substrate **(41-Figures 1 & 2)** on the plate **(13-Figures 1 & 2)** comprising a plurality of contacts **(43-Figures 3 & 4)** configured to electrically contact the pads **(27-Figures 1-3)**;

a clamping mechanism **(89-Figure 8)** attached to the plate **(13-Figure 8)** configured to bias the contacts **(43-Figures 3 & 4)** and the pads **(27-Figures 1-3)** together with a force;

the plate **(13-Figures 1 & 2)**, the substrate **(41-Figure 2)** and the mechanism **(89-Figure 8)** configured such that the die **(21-Figure 2)** can be placed on the substrate

(41-Figure 2), the mechanism **(89-Figure 8)** attached to the plate **(13-Figur 8)**, and the die **(21-Figure 2)** retained between the mechanism **(89-Figur 8)** and the substrate **(41-Figure 2)** with the contacts **(43-Figures 3 & 4)** in electrical contact with the pads **(27-Figures 1-3)**; and

each contact **(43-Figures 3 & 4)** comprising a bump **(43 or 61-Figures 4-6)** and a plurality of spaced raised portions **(asperties 69-Figure 4 or raised portions 73-Figure 6)** projecting from the bump **(Figure 4)**, the raised portions **(asperties 69-Figure 4 or raised portions 73-Figure 6)** dimensioned to penetrate into a pad **(27-Figure 4)** at the force to a penetration depth equal to a height of the raised portions **(asperties 69-Figure 4 or raised portions 73-Figure 6)** but less than a thickness of the pad **(27-Figure 4)**, the bump **(43 or 61-Figures 4-6)** dimensioned to limit further penetration of the raised portions **(asperties 69-Figure 4)** into the pad **(27-Figure 4)** at the force.

87. An apparatus **(fixture 11-Figures 1 & 2)** for testing a semiconductor die **(21-Figure 2)** having a plurality of pads **(27-Figures 1-3)** comprising:

a plate **(13-Figures 1 & 2)** comprising a plurality of external leads **(33-Figures 1 & 2)**;

a substrate **(41-Figures 1 & 2)** on the plate **(13-Figures 1 & 2)** comprising a plurality of contacts **(43-Figures 3 & 4)** configured to electrically contact the pads **(27-Figures 1-3)**;

a clamping mechanism **(89-Figure 8)** attached to the plate **(13-Figure 8)** configured to bias the contacts **(43-Figures 3 & 4)** and the pads **(27-Figures 1-3)** together with a force;

the plate **(13-Figures 1 & 2)**, the substrate **(41-Figure 2)** and the mechanism **(89-Figure 8)** configured such that the die **(21-Figure 2)** can be placed on the substrate

(41-Figure 2), the mechanism **(89-Figure 8)** attached to the plate **(13-Figure 8)**, and the die **(21-Figure 2)** retained between the mechanism **(89-Figure 8)** and the substrate **(41-Figure 2)** with the contacts **(43-Figures 3 & 4)** in electrical contact with the pads **(27-Figures 1-3)**; and

each contact **(43-Figures 3 & 4)** comprising a bump **(43 or 61-Figures 4-6)** and a plurality of spaced raised portions **(asperties 69-Figure 4 or raised portions 73-Figure 6)** projecting from the bump **(Figure 4)** with a height, the raised portions **(asperties 69-Figure 4 or raised portions 73-Figure 6)** configured to penetrate into a pad **(27-Figure 4)** with a penetration depth equal to the height but less than a thickness of the pad **(27-Figure 4)** while the bump **(43 or 61-Figures 4-6)** limits further penetration, the force selected to be greater than a first force at which the raised portions **(asperties 69-Figure 4 or raised portions 73-Figure 6)** penetrate the pad **(27-Figure 4)** but less than a second force at which the bump **(43 or 61-Figures 4-6)** penetrate the pad **(27-Figure 4)**, the second force being from two to ten times the first force; and

a plurality of conductive traces **(45-Figures 1 or 4)** on the substrate **(41-Figure 1 or 4)** in electrical communication with the contacts **(43-Figures 3 & 4)** and with the external leads **(33-Figures 1 & 2)**.

92. An apparatus **(fixture 11-Figures 1 & 2)** for testing a semiconductor die **(21-Figure 2)** having a plurality of pads **(27-Figures 1-3)** comprising:

a plate **(13-Figures 1 & 2)**;

a substrate **(41-Figures 1 & 2)** on the plate **(13-Figures 1 & 2)** comprising a plurality of contacts **(43-Figures 3 & 4)** configured to electrically contact the pads **(27-Figures 1-3)**;

a clamping mechanism **(89-Figure 8)** attached to the plate **(13-Figure 8)** configured to bias the contacts **(43-Figures 3 & 4)** and the pads **(27-Figures 1-3)** together with a force;

the plate **(13-Figures 1 & 2)**, the substrate **(41-Figure 2)** and the mechanism **(89-Figure 8)** configured such that the die **(21-Figure 2)** can be placed on the substrate **(41-Figure 2)**, the mechanism **(89-Figure 8)** attached to the plate **(13-Figure 8)**, and the die **(21-Figure 2)** retained between the mechanism **(89-Figure 8)** and the substrate **(41-Figure 2)** with the contacts **(43-Figures 3 & 4)** in electrical contact with the pads **(27-Figures 1-3)**;

each contact **(43-Figures 3 & 4)** comprising a bump **(61-Figure 6)** having a surface **(Figure 6)** and a plurality of spaced raised portions **(73-Figure 6)** projecting from the surface dimensioned to penetrate into a pad **(27-Figure 6)** at the force by a penetration depth equal to a height of the raised portions but less than a thickness of the pad **(27-Figure 6)** while the surface limits further penetration into the pad, the force selected to be greater than a first force at which the raised portions **(73-Figure 6)** penetrate the pad **(27-Figure 6)** but less than a second force at which the bump **(61-Figure 6)** penetrates the pad **(27-Figure 6)**.

97. An apparatus **(fixture 11-Figures 1 & 2)** for testing a semiconductor die **(21-Figure 2)** having a pad **(27-Figures 1-3)** with a thickness comprising:

a plate **(13-Figures 1 & 2)**;

a substrate **(41-Figures 1 & 2)** on the plate **(13-Figures 1 & 2)** comprising a contact **(43-Figures 3 & 4)** configured to electrically contact the pad **(27-Figures 1-3)**, the contact **(43-Figures 3 & 4)** comprising a bump having a surface **(Figure 6)** and at least one raised portion **(73-Figure 6)** projecting from the surface with a height, the raised portion **(73-Figur 6)** and the surface configured such that the raised portion **(73-Figure 6)** can penetrate

into the pad **(27-Figures 1-3)** to a penetration depth equal to the height but less than the thickness while the surface **(Figure 6)** limits further penetration into the pad **(27-Figures 1-3)**; and

a clamping mechanism **(89-Figure 8)** attached to the plate **(13-Figures 1 & 2)** configured to bias the die **(21-Figure 2)** and the substrate **(41-Figures 1 & 2)** together with a force selected to achieve penetration of the pad **(27-Figures 1-3)** by the raised portion **(73-Figure 6)** but to prevent damage to the pad **(27-Figures 1-3)** by the bump.

Antecedent basis for "bump" is provided on page 15, line 24 of the specification.

Antecedent basis for "raised portions" is provided on page 17, line 20 of the specification.

Antecedent basis for "height" is provided on page 15, line 6, of the specification.

Antecedent basis for "force" and "penetration" is provided on page 17, line 25 to page 18-line 15 of the specification.

6. ISSUES (37 CFR 1.192 (c) (6))

A first issue is whether claims 78-82, 87, 88, 90-93 and 96-98 are unobvious under 35 U.S.C. 103(a) over Malhi et al. (US Patent No. 5,088,190) or Elder et al. (US Patent No. 5,123,850) in a first set, in view of Nakano (JP Hei 3-69131) in a second set, and Blonder et al. (US Patent No. 4,937,653) or Bindra et al. (US Patent No. 5,137,461) in a third set.

A second issue is whether claims 78-82, 87, 88, 90-93 and 96-98 are unobvious under 35 U.S.C. 103(a) over Nakano (JP Hei 3-69131) in a first set, in view of Blonder et al. (US Patent No. 4,937,653) or Bindra et al. (US Patent No. 5,137,461) in a second set.

7. GROUPING OF CLAIMS (37 CFR 1.192(c)(7))

The following groups of claims are deemed to separately stand or fall together.

Group I - Claims 78-82.

Group II - Claims 87-88 and 90-91.

Group III - Claims 92-93 and 96.

Group IV - Claims 97-98.

8. ARGUMENT
REJECTIONS UNDER 35 USC §103 (37 CFR 1.192(C)(8)(iv)

Appellant submits that the 35 USC §103 rejections are in error, and that the present claims are unobvious over the prior art. As a first argument, Appellant submits the claims are unobvious because they include limitations not taught or suggested by the prior art. As a second argument, Appellant submits that one skilled in the art at the time of the invention would have no incentive to combine the references in the manner of the Office Action.

The criteria of MPEP 2142, 2143 on establishing obvious are thus not met by the rejections. Specifically, MPEP 2142, 2143 states as follows:

"First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success in obtaining the claimed invention based upon the references relied upon by the Examiner. Third, the prior art reference (or references when combined) must teach or suggest all the claim limitations."

First Argument - Claim Limitations Not Taught Or Suggested By Prior Art

Malhi et al. and Elder et al. in the first set were cited as teaching test apparatus similar to the presently claimed test apparatus. As stated in the final Office Action dated October 5, 2001:

"The first set shows all the major elements of the claimed invention except for the specific contacts and a

clamping mechanism producing a specific force range. The first set does have a clamping mechanism."

The test apparatus disclosed in Malhi et al. and Elder et al. were developed in the early 1990s by semiconductor manufacturers to test and certify singulated semiconductor dice as known good dice (KGD). Specifically, singulated dice can be temporarily packaged in these test apparatus, then burn in tested at elevated temperatures in a burn in oven. The passing dice could then be packaged, or used individually in bare form. Prior to that time dice were tested at the wafer level, particularly with probe cards, but were not burn in tested until after packaging. If a packaged die was determined to be defective after burn in testing, the packaging costs were wasted.

As with the presently claimed test apparatus, the test apparatus of Malhi et al. and Elder et al. also include a plate for holding the die, a substrate with contacts for electrically engaging the die, and a clamping mechanism for biasing the die and the substrate together. However, problems would occur during prior art tests because the contacts on the test apparatus would damage the dice. In particular, in order to make good electrical connections with the dice a large biasing force needs to be applied. This problem is compounded because each test apparatus is a self contained unit, that is used many times to test dice having different physical characteristics, such as pad height and planarity. Accordingly, the biasing force was oversized even more to insure good electrical contact.

The present test apparatus includes a substrate with contacts having a self limiting penetration depth. In addition, the present test apparatus relates the self limiting nature of the contacts to the biasing force applied by the clamping mechanism. Specifically, the raised portions (73-Figure 6) of the contacts (61-Figure 8) penetrate the pads (27-Figure 6) on the die (21-Figure 6) at the selected

biasing force, while the remainder of the contacts (e.g., the flat surface on the bump 61 in Figure 6) provide a stop plane for limiting further penetration. Damage to the die is thus limited, and the upper and lower limits of the biasing force applied by the clamping mechanism can be quantified.

Appellant submits that the feature of a penetration limiting contacts in combination with a clamping mechanism is not taught or suggested by the cited art. This feature is recited in each independent claim (claims 78, 87, 92 and 97). Appellant further submits that the feature of relating the biasing force of the clamping mechanism to the structure of the penetration limiting contacts is not taught or suggested by the cited art. This feature is also recited in each independent claim.

In this regard the Nakano reference of the second set has been cited by the Examiner as teaching a penetration limiting contact. As stated in the final Office Action dated October 5, 2001:

> "The second set shows a contact of the type claimed except it has a single raised portion instead of plural raised portions."

Although Nakano et al. teaches a penetration limiting contact, there is no suggestion of using this type of contact with a clamping mechanism. In addition, there is no suggestion of relating a biasing force applied by the clamping mechanism to the structure of the penetration limiting contact. Specifically, Nakano et al. is directed to a probe card, such that the biasing force for biasing the contact with the wafer is externally generated by something other than a clamping mechanism configured as presently claimed (e.g., movement of the wafer or the probe card by a hydraulic cylinder or a press). This biasing force can be precisely ascertained and controlled, and does not need to be oversized as in the present test apparatus.

The final Office Action dated October 5, 2001 states:

"Applicants' arguments that Nakano has no clamping mechanism are contested by the Examiner. No drawing exists in Nakano showing a clamping mechanism, but Nakano indicates that the probe of figure 2a "butts up against pad 25" and "deep scoring of pad 25 by probe contact 22 is prevented". (See page 5, lines 17 plus of Nakano et al.) Something has to force the probe against that being tested. It might be a weight, a press or a clamp. All would seem equivalent and obvious to one skilled in the art. Note that the first set uses clamps. Both Blonder et al. and Bindra et al. must use something akin to a clamp to hold the parts together. Anything that is held together is "clamped". The size of the clamp is not relevant."

However, the present claims place specific limitations on the structure and function of the clamping mechanism. For example, independent claims 78, 87 and 92 state: "the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads". Although such a clamping arrangement is known in the art, this arrangement in combination with a contact configured to penetrate, and to limit penetration, as a function of biasing force applied by the clamping mechanism is not suggested by the art.

Blonder et al. and Bindra et al. of the third set were cited as teaching plural raised points on a contact structure. However, both of these references teach permanent, rather than temporary electrical connections, as in a test apparatus. Specifically, Blonder et al. teaches a permanent connection system that requires "bonding of the carrier pads to the chip pads" (col. 2, lines 40-41). Further, Blonder et al. does not relate contact force to penetration depth. Rather as explained in column 4, lines 49-55 of Blonder et al., an external mechanical pressure is applied to the chips and carrier. Again this pressure can be mechanically controlled, and a special contact structure to limit the penetration depth, as a function of contact pressure is not required.

Bindra et al. describes a separable electrical connection technology that uses interdigitating members 62. Figure 20 illustrates the mechanical connection of the interdigitating members 62 to a solder ball 61. As stated at column 8, lines 37-38 of Bindra et al. a "pressure insertion" is employed. Presumably this pressure could be selected as required, and "penetration limitation at a selected contact force" would not be a consideration with this reference.

As both references of the third set teach plural points in the context of bonded connections there is no suggestion of penetration limitation, as a function of biasing force applied by a clamping mechanism.

Further, independent claim 78 relates the biasing force to the structure of the penetration limiting contacts by reciting "the bump dimensioned to limit further penetration of the raised portions into the pad at the force". Independent claim 87 quantifies the forces by reciting "the second force being from two to ten times the first force". Similarly, independent claim 92 recites "the force selected to be greater than a first force at which the raised portions penetrate the pad but less than a second force at which the bump penetrates the pad". Similarly, independent claim 97 recites the "force selected to achieve penetration of the pad by the raised portion but to prevent damage to the pad by the bump".

In this regard the final Office Action dated October 5, 2001 states:

"One skilled in the art would apply a force sufficient to make good contact and not so great as to destroy that being tested. Applicants' claimed ranges fall within that category."

However, the present claims quantify the biasing force as a function of the contact structure, rather than on the basis of good contact or destructive contact. In addition, neither good contact force nor destructive contact force are

quantified in the prior art, as they may vary according to the characteristics of the dice. For example, a die with pads on a planar surface is easier to make contact with than a die with pads on a non-planar surface. Further, a destructive contact force is outside of the present claimed range, such that the present force limitations are narrower than the prior art. Although the force limitations fall within the range of the prior art, they are still unobvious over the prior art.

Because the above features are not taught or suggested by the cited art, Appellant submits that the combination of Malhi et al. and Elder et al. in a first set, Nakano et al. in a second set, and Blonder et al. or Bindra et al. in a third set does not render the present claims as obvious.

Similarly Appellant submits that the claims are unobvious over Nakano et al. in a first set in view of Blonder et al. or Bindra et al. in a second set for exactly the same reasons.

Second Argument - No Incentive To Combine Cited References

Appellant would further argue that there is no incentive in the references, or in the prior art, for combining the references in the manner of the Office Action.

In regard to the motivation to combine the references, the final Office Action dated October 5, 2001 states:

"It would have been obvious to one of ordinary skill in the art at the time of the invention was made to have adapted the contact structure of the second set modified to have plural raised portions in accord with the third set to the apparatus of the first set because one of ordinary skill in the art would realize that so doing would result in better contact being made."

In response, Appellant submits that the contacts disclosed in Malhi et al., and in Elder et al., are designed to make good electrical contact. It is arguable that a penetration limiting contact as disclosed by Nakano et al. would make better electrical contact. For example, as shown

in Figure 3, and described at column 6, line 16 of Malhi et al., the solder bumps 331, 332, 333 and 334 in combination with compliant layer 31 cooperate to make "positive connection" with land pads 301, 302, 303, 304 on the die 11. Similarly, as stated at column 4, lines 32-35 of Elder et al.: "The compression of elastomer 25 provides slight scrubbing action which is necessary for good electrical contact between the contact bumps 24 and test pads on the semiconductor die."

Further, Nakano et al. is directed to a probe card and contains no teachings that a penetration limiting contact would make better contact in testing apparatus that employ a clamping mechanism. Similarly, Blonder et al. and Bindra et al. are directed to permanently bonded connections, and contain no teachings that a multiple pointed contact would make better temporary electrical contacts in testing apparatus that employ a clamping mechanism.

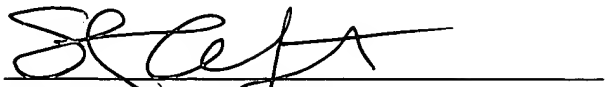
In combining the references, the motivation for the combination must be from the view point of one skilled in the art at the time of the present invention, and without the benefit of the present disclosure. However, there is no suggestion in the art of combining a penetration limiting contact having multiple penetration points, with a clamping mechanism constructed to relate biasing force to the structure of the contact.

Conclusion

In view of the above arguments, Appellant submits the rejections of claims 78-82, 87, 88, 90-93 and 96-98 are not proper. Appellant thus requests the rejections be reversed, and the claims be allowed.

DATED this 28th day of March, 2002.

Respectfully submitted:



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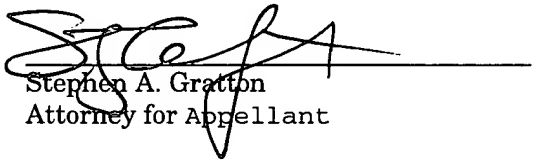

Stephen A. Gratton
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Appendix
Appellant's Brief

Pending Claims
Application Serial No.: 08/838,452

78. (six times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

a plate;

a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;

a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads; and

each contact comprising a bump and a plurality of spaced raised portions projecting from the bump with a height, the raised portions dimensioned to penetrate into a pad at the force to a penetration depth equal to the height but less than a thickness of the pad, the bump dimensioned to limit further penetration of the raised portions into the pad at the force.

79. (five times amended) The apparatus of claim 78 wherein the bump is dimensioned to penetrate into the pad at a second force which is about two to ten times the force.

80. (five times amended) The apparatus of claim 78 further comprising a plurality of conductive traces on the substrate in electrical communication with the contacts, and

a plurality of external contacts on the plate in electrical communication with the traces.

81. (five times amended) The apparatus of claim 78 wherein the height is about 5000Å.

82. (five times amended) The apparatus of claim 78 wherein the pads comprises bondpads.

87. (five times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

a plate comprising a plurality of external leads;

a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;

a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads;

each contact comprising a bump and a plurality of spaced raised portions projecting from the bump with a height, the raised portions configured to penetrate into a pad with a penetration depth equal to the height but less than a thickness of the pad while the bump limits further penetration, the force selected to be greater than a first force at which the raised portions penetrate the pad but less than a second force at which the bump penetrates the pad, the second force being from two to ten times the first force.

88. (four times amended) The apparatus of claim 87 wherein the height is at least 5000Å.

90. (four times amended) The apparatus of claim 87 wherein the bump comprises a surface and the raised portions project from the surface.

91. (four times amended) The apparatus of claim 87 further comprising a plurality of bond pads on the conductive traces.

92. (four times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

a plate;

a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;

a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads;

each contact comprising a bump having a surface and a plurality of spaced raised portions projecting from the surface dimensioned to penetrate into a pad at the force by a penetration depth equal to a height of the raised portions but less than a thickness of the pad while the surface limits further penetration into the pad, the force selected to be greater than a first force at which the raised portions penetrate the pad but less than a second force at which the bump penetrates the pad.

93. (four times amended) The apparatus of claim 92 further comprising a plurality of external leads on the plate in electrical communication with the contacts.

96. (four times amended) The apparatus of claim 92 wherein the raised portions comprise points.

97. An apparatus for testing a semiconductor die having a pad with a thickness comprising:

a plate;

a substrate on the plate comprising a contact configured to electrically contact the pad, the contact comprising a bump having a surface and at least one raised portion projecting from the surface with a height, the raised portion and the surface configured such that the raised portion can penetrate into the pad to a penetration depth equal to the height but less than the thickness while the surface limits further penetration into the pad; and

a clamping mechanism attached to the plate configured to bias the die and the substrate together with a force selected to achieve penetration of the pad by the raised portion but to prevent damage to the pad by the bump.

98. The apparatus of claim 97 wherein the contact comprises a plurality of raised portions and the raised portions comprise pointed members.